Biomass assessment for power generation in Balijana block, Goalpara district, Assam

Sponsored by

Ministry of Non Conventional Energy Sources, New Delhi

Implemented by

Assam Science Technology and Environment Council Guwahati

Coordinated by

School of Energy Studies, Jadavpur University, Kolkata

Conducted by

teri

Tata Energy Research Institute

TERI Project Report No. 2001 NE 63

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Executive Summary

The proposed study conducted under the National Biomass Resource Assessment Program of the Ministry of Non Conventional Energy Sources seeks to assess the surplus availability of biomass resources for power generation in Balijana block of Goalpara district, Assam The focus is on crop residues and woody biomass. Primary survey of the villages supplemented by secondary data of the block is the basis of the estimations.

Net cropped area in the block accounts for 31 68% of the block's total geographical area of 28 634 ha. Field crops such as paddy (*Sali, Ahu, Boro*), wheat, maize, rapeseed and mustard, pulses (black gram, green gram, arhar, lentil), sesamum, jute, are grown in different seasons. The total crop residue generated in the block is totally utilised as feedstock, organic matter and thatching Though the forest area (reserve forests, proposed reserve forests and social forestry plantations) in the block is about 14 729.6 ha but the annual sustainable yield of woody biomass from forests is far below the consumption levels, leading to a deficit of wood availability in the block. Thus there is no availability of surplus woody biomass or crop residue in the block *Hence, the present assessment study does not yield an over all feasibility for biomass based power generation in the Balijana block..*

Thus it is recommended to take up plantations of fast growing tree species in the block for catering to the increasing fuelwood demand in the block. In addition, improved cookstoves may be disseminated in large numbers for reduced consumption of fuelwood, which will help in the conservation of the forests These measures would help in the reduction of fuelwood consumption and simultaneously increase the forest yield

Balijana block at a glance

Profile	District	: Goalpara
	Block HQ	: Balijana
	Location	: 26^0 N and 91^0 E
	Gaon Panchayats	: 10
	Total villages	: 125
	Geographical area	: 286 34 km^2
	Distance from district HQ	10 km
	Distance from State capital	140 km

Topography and climate	Located in the Brahmaputra plains, the block is characterised by an almost flat plain except for few low-forested hills that break the monotony of the terrain is moderate during the winter and hot in summer. The maximum temperature is 33^0 C in July and August and the minimum temperature falls upto 7^0 C in the month of January
Total annual rainfall	1 614 mm

Demography	Households	. 15 372 (Primary survey 2001)
	Population	83 185 (1998 BPL census)
	Scheduled Castes	5 37% (1991 census)
	Scheduled Tribe	: 35 12% (1991 census)
	Literacy rate	40 47% (1991 census)
Infrastructure	Electrified villages	: 66
	Road communication	. mostly gravel roads
	Schools (Primary, Middle and High)	. 135
	Colleges and Hr Sec schools	10
	Public health centre/state dispensary	5
	Bank	. 4
	Post office (incl. sub post office)	4
Transportation	Nearest Railway Station	: Goalpara (10 km from block HQ)
	Nearest Airport	: Guwahati (130 km from block HQ)
	Nearest National Highway	: NH 37 (passes through the block HQ)
Industry	Small rice mills, oil expelling and weaving.	

Land-use

Gross cropped area	: 15 767 ha
Net cropped area	: 9 071 ha
Total irrigated area	· 1 639 ha
Barren land	. 1 211.05 ha
Fallow land	: 553.68 ha
Grazing land	· 1 264 ha
Land under plantation (rubber)	: 367 ha
Land under misc. trees, groves	: 274.62 ha
Homestead	: 1 893.7 ha

Forests

Reserve Forests: 8 607 97 ha, Proposed Reserve Forests. 4 701.63 ha; Social Forestry plantation: 1 420 ha.

Crops grown

Crops	*Area (ha)*	*Production (t/y)*
Paddy	9740.84	24 832 88
Rapeseed & Mustard	635	3 55 05
Pulses	501.1	377 5
Wheat	295.1	433.77
Maize	89.6	200.04
Sessamum	103.8	36 59
Jute	83	159.38

Livestock

Cattle, buffalo pigs, poultry, duck, sheep and goats.

Total livestock population 136 946 (Cattle· 40 308, Buffalo 614

Goat/sheeps:7 333, poultry/ducks 81 267 and others· 7 424)

Biomass generation

ton/year

Sources	*Woody*	*Leafy*	*Powdery*	*To*
Forests	53 684 53	17 746.13	-	71 430
Agriculture lands	1 126 70	45 856.38	6 630.38	53 613
Homesteads/ others	1 155 60	2 726.52	-	3 882
Total	55 966.83	66 329.03	6 630.38	12 8926.

Biomass consumption

ton/year

End use	*Woody*	*Leafy*	*Powdery*	*To*
Fodder	-	73 063.61	6 630.38	79 693.
Fuel	103 992.35	-	-	103 992.
Manure	-	1 215 60	-	1 215.
Thatching	-	1 334.40	-	1 334
Total	103 992 35	75 613.61	6 630 38	18 6236

Biomass surplus (deficit) ton/year	Woody	Nil (– 48 025.52)
	Leafy	Nil (– 9 284.58)
	Powdery	Nil
	Total	Nil (– 57 310 10)

Biomass available for power generation None

Plan of action Plantation of fast growing tree species in selected villages to increase woody biomass availability Dissemination of improved cookstoves to reduce fuelwood consumption

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Chapter 1

Introduction and methodology

1.1 Introduction

Biomass resources comprise organic matter derived directly or indirectly from forestry and agriculture or livestock activities, namely wood, crop residues, and animal wastes Given the overwhelming dependence of India's rural population on traditional biomass resources for meeting its energy demand, the effective utilization of such resources requires focused planning efforts. More so, because of the limited options in terms of fuel sources available in rural areas. Fuelwood continues to be the main domestic fuel in rural households. Fuelwood, agricultural residues and animal dung contribute between 90-95% of the total fuel consumed in domestic sector, of which fuelwood alone accounts for 65% (NCAER 1985)

It is estimated that approximately 405 million tonnes of biomass is generated every year in the country (MNES 1999) This includes rice husk, saw dust, sugarcane baggasse, coir-pith, coffee wastes and groundnut shells India has a potential of generating 19 500 MW of power by processing biomass through cogeneration, combustion and gasification routes (MNES 2001)

1.2 Objective of the study

The study is being conducted under National Biomass Resource Assessment Programme (NBRAP) of the Ministry of Non Conventional Energy Sources (MNES). The overall objective is to assess the availability of surplus biomass resources for gasifier based power generation in Balijana block of Goalpara district, Assam. The key parameters studied are as follows

1. Assessment of availability, production and utilization of biomass in Balijana block, Goalpara district in Assam through household/village/block level primary survey.
2. Estimation of surplus biomass availability in the block
3. Assessment of quantum of electricity to be generated from surplus biomass in the selected block and capacity of power plants to be installed.

1.3 Methodology

The study is primarily designed to estimate the availability of likely surplus biomass for power generation in Balijana block, Goalpara district, Assam and the power requirements of the block The focus is on crop residues and woody biomass. Primary surveys of the villages in the study block supplemented by secondary data are the basis of the estimations made under the study For the present study, secondary data have

been reconciled with primary data collected for corroborating the total information requirements

1.3.1 Secondary data collection

Detailed information was sought from the secondary sources. Data related to demographic, social, and economic parameters were collected to understand the land use pattern, resource management systems, productivity of biomass, etc. Apart from the available literature, most of the data collected were based on personal interactions with relevant agencies (Block development office, Agriculture Department, PWD, Forest Department, ASEB, Directorate of Industries and Commerce, etc) as also with knowledgeable individuals and organizations. Table 1.1 provides the details on the type and source of the data collected.

Table 1.1 Type and source of secondary data

Information	*Source*
District	
Census records and district profile	Directorate of Census, NICNET
Land use, Cropping pattern, Irrigation schemes	District Agriculture Office
Industrial profile	Directorate of Industries and commerce
Power supply and consumption	ASEB, Goalpara division
Forest area, sustainable yield of forest	Divisional Forest Officer, Goalpara Forest Survey of India
Block	
Households, Population, infrastructure	Circle Office, Block Development Office,
Land use, grain production, irrigation systems, agriculture markets	Agriculture Extension Officer, Village level extension worker (VLEW)
Industries	District Industries & Commerce Centre
Power supply and consumption, LPG consumption	ASEB Goalpara division, LPG distribution agencies
Livestock	District Animal husbandry and Veterinary Officer
Road connectivity	Public Works Department (Roads)
Village	
Household data, population, electrification status, livestock, type of biomass residues- generation and consumption etc	Primary survey

1.3.2 Selection of villages

For the proposed study, 101 villages out of the total 125 villages in Balijana block were surveyed for primary data collection The number of villages was selected according to the guidelines of NBRAP of MNES. A minimum of 50% of the villages for each of the 10 GPs in the block was selected for survey and in 2 GPs 100% villages were surveyed

The Block Development Office and the Circle Office provided the list of the villages and the block map respectively.

1.3.3 Primary data collection

Primary data were collected from the surveyed villages to ascertain the resources available and their utilisation patterns, and the prevalent socio-economic practices Focus group discussion was held with the village headman and the village elders/school teachers to collect the exact information An assessment was made of the electricity consumption and likely demand, crop residue availability, fuelwood use and infrastructural needs In the surveyed villages, survey schedules were administered at the household level, industry/commercial establishment and village level. The detail on the type & source of information collected are given in Table 1.2

Table 1.2 Type and sources of primary information

Information	Source
Household no, Population, industries, village electrification status and no of electrified households, land use, agriculture crop production, irrigation etc	Village headman, households, commercial establishments, local shopkeepers
Livestock, biomass collection and consumption, agriculture development, market prices, etc	Households, commercial establishments, village headmen
Power consumption pattern, biomass processed or consumed, electricity consumption, kerosene/diesel consumption, operational periods of industrial units.	Commercial establishments, restaurants, and households, ASEB

1.4 Data analysis

To assess the biomass supply from the various sources and its consumption by different end-users and the surplus available; computations were based on secondary and primary information. The following methodology was used to arrive at the estimations.

1.4.1 Agriculture residues

This is a factor of agricultural area, crop type, the grain yield and the Residue Production Ratio (RPR)

Residue production (t)= Crop production (t) × RPR

1.4.2 Woody biomass

The major sources of woody biomass are the reserve forests (RF) and the proposed reserve forests (PRF) Plantations established by Social Forestry (SF) Division of the Forest Department are also available in the block, but generally these couldn't be

harvested because of government restriction, but it was found during primary survey that biomass generated from social forestry plantations are also harvested. So biomass supply from RF, PRF, SF and homestead has been taken into account for calculation of woody biomass availability. As no annual growth data are available with the forest department, **growing stock method** was adopted for calculating the yield and the results were checked with those obtained from Net Primary Production (NPP) methods for accuracy (FAO-RWEDP 2001). Further, for social forestry plantation yield calculation, NPP for plantation wood was considered, as productivity and growing stock values were not available for such type of plantations.

Yield (ton /ha/year) = 2 × growing stock / rotation [1]
Total annual yield (ton/year) = Annual yield (ton/ ha/year) × area (ha)

1.4 3 Assessment of biomass consumption

For the domestic sector, fuelwood used for cooking at the household level, hotels and tea stalls was assessed to obtain the annual wood consumption at the block level. Similarly, for crop residues, the quantum used for end-uses of fuel, fodder, thatching and manure is discounted from the total residue production to estimate the surplus. In addition, fuelwood and crop residue harvesting and disposal practices, transportation arrangements, and prevalent market prices of biomass were also studied at the village level. The commercial sector in the block comprises mainly of shops and restaurants, wherein mainly firewood is utilised for cooking. The industrial sector consisting of small-scale units such as rice mills and oil mills consume diesel and electricity to run their operations.

Annual domestic fuelwood consumption = number of households × average fuelwood consumption (kg/month) × 12 months

Annual commercial fuelwood consumption = number of establishments × average commercial fuelwood consumption (kg/day) × 365 days

1.4.4 Assessment of kerosene/diesel consumption

Kerosene consumption is calculated on the basis of primary survey at household level whereas diesel consumption is based on the consumption by the rice mills and other commercial establishments.

1 FAO-RWEDP 2001 *Wood Energy News* 16(2) pp 16

Annual kerosene consumption at block level = number of households × average household consumption (litre/month) × 12 months

Annual diesel consumption at block level = number of mills × average daily consumption (litre/day) × average number of operational days per year

1.4.5 Assessment of LPG consumption

LPG consumption is calculated on the basis of primary survey at household level.

Annual LPG consumption at block level = Average household consumption × number of LPG households (kg/month) × 12 months

1.4.6 Power consumption in domestic sector

Power consumption by domestic sector is calculated on basis of primary surveys at the household level and village level

Total annual consumption (kWh/year) = Average household power consumption (kWh/month) × Total electrified households × 12 months

1.4.7 Power consumption in commercial and industrial sector

Power consumption by industrial sector is computed from data obtained from primary survey as well as ASEB records

Total annual consumption (kWh/year) = Average commercial power consumption (kWh/month) × Total number of consumers × 12 months

1.5 Power generation potential

Biomass based power generation is dependent on the type of biomass conversion technology to be adopted and feedstock to be used. Biomass conversion technologies are under refinement and the input-output ratios are being standardised for various feedstocks, especially for dual fuel mode based gasifier units. In a gasifier based dual fuel mode of operation, the specific fuel consumption per unit generation is as follows.

Wood: 1.0 kg/kWh and Diesel: 100 ml/kWh (Jain 1994)

Crop residue: 1.5 kg/kWh (Ankur 1998)

Chapter 2

Profile of taluka

2.1 Goalpara district

The Goalpara district lies between latitudes 25.53^0 and 26.30^0 N and longitude 90.07^0 and 91.05^0 E. The district shares its boundary with Dhubri and Bongaigaon district in north, Meghalaya State in south, Kamrup district in east and Dhubri district in the west. The total geographical area of the district is 1 824 km^2 (Assam State Gazetteer 1999) and is divided into five revenue circles: Balijana, Lakhipur, Matia, Rangjuli and Dudhnoi. There are eight community blocks in the district namely Balijana, Rangjuli, Matia, Lakhipur, Kharmuja, Krishnai, Kuchdhowa and Jaleswar.

Table 2.1 Goalpara district at a glance

Geographical area	1 824 km^2
Total Towns	2
Revenue Circles	5
Community Development Blocks	8
Total Gaon panchayats	81
Total Villages	834
Total Population	8 22 306 (2001 census)
Sex ratio	955
ST (Schedule Tribes)	1 15 099
SC (Schedule Castes)	36 746
Literacy rate	58 56%
Density of population	451
Plains Area	1 511 km^2
Net Cultivated Area	76 807 ha
Forest Area	400 km^2
Number of Colleges	8
Higher Secondary School	15
High School	147
Primary & Middle School	1436
Distance from state capital	150 Km

Source: NIC, Goalpara district unit 2001 and NEDFi 2001

2.1.1 Topography

The topography of Goalpara District is generally characterised by an almost flat plain except for few low-forested hills that break the monotony of the terrain. The main hills

are Pancharatna, Sri Surjya, Tukreswari, Nalanga. Ajogar & Paglartek with elevations ranging from 100 to 500 m. A large number of *char* (riverine tracts and sandy river island) are found in the river Brahmaputra, which flows from east to west on the northern boundary of the district. The main tributaries of Brahmaputra flowing through the district are Dudhnoi, Krishnai, Jinjiram and Jinary rivers. There are also few minor streams and a number of *beels* (wetland) such as Urapd beel, Hashila beel, Kumri beel and Dhamar Risan beel in the district. About 22% of the district's total land area is under forest cover.

2.1.2 Climate

The climate in the Goalpara District is moderate during the winter and hot in summer. Rain makes its appearance in the month of April with occasional and irregular light showers. This irregular rainfall continues upto the end of May. Monsoon rain normally begins from the early part of the month of June and heavy downpour occurs in the district till the end of September. The maximum temperature is 33^{0} C in the Month of July and August and the minimum temperature falls upto 7^{0} C in the month of January. The annual rainfall of the district is 1 614 mm of which about 80% are from Southwest monsoon.

2.1.3 Economy

The district is primarily agrarian with about 90% of the population depending on agriculture for their livelihood. The principal agriculture produce is paddy, jute, green and black gram and vegetables etc. The district is also known for its production of arecanut and banana. The district witnessed a bumper production of paddy during the last two-year due to large-scale distribution of shallow tube wells along with diesel water pump sets by the state agriculture department. Industrially, the district is very backward as no big industry worth the name exists. It is land-locked with poor transport and communication facilities. However, the proposed industrial growth centre of Matia is expectea to give a boost to the development of industries in the district.

2.2 Balijana block

Balijana block occupies the central northern part of Goalpara district. To its east lie the Matia circle; Kharmoza block and Lakhipur circle towards west, Krishnai block in the south, Meghalaya State in the Southwest and the river Brahmaputra to its north (Fig 1). The block falls under the administrative jurisdiction of the Goalpara Sub-division. Balijana block has ten *Gaon Panchayats* (GP) consisting of 125 villages under its jurisdiction (Fig 2). The total geographical area of the block is 286.34 sq km.

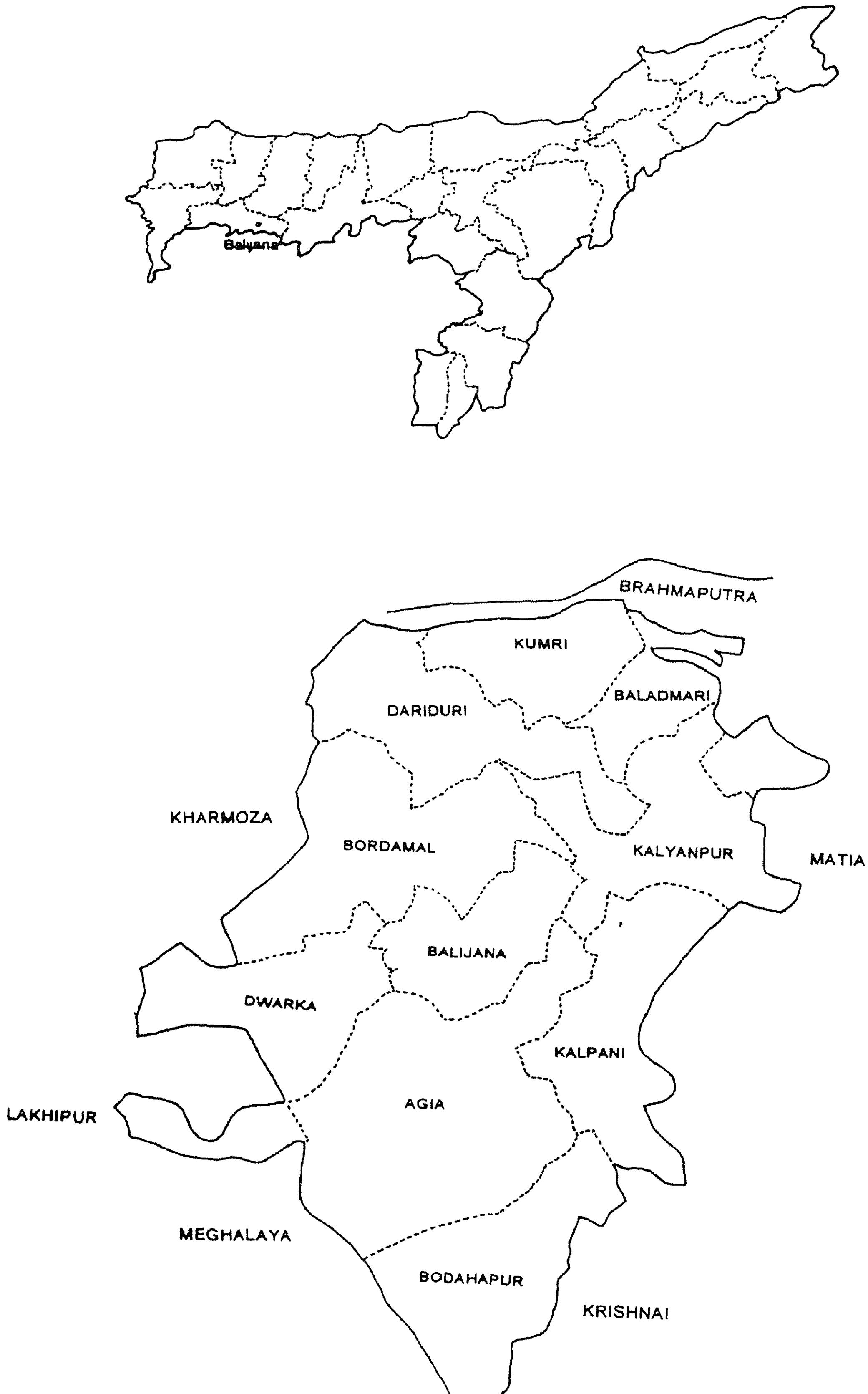


Fig 1 Location of Balijana block and its Gaon panchayats

Table 2.2 Balijana block at a glance

Total Villages	125
Geographical area	286.34 km^2
Households	15 094 (1998 BPL census)
	15 372 (Primary survey 2001)
Total Population	83 185 (1998 BPL census)
	89 121 (Primary survey 2001)
ST (Schedule Tribes)	35.12% (1991 census)
SC (Schedule Castes)	5.37% (1991 census)
Literacy rate	40.47% (1991 census)
Density of population	290.51
Distance from district HQ	10 Km
Distance from state capital	140 Km

Source: Block Development Office, Balijana 2001

2.2.1 *Demography and socio-cultural profile*

The population of Balijana block is mainly rural, accounting for about 11% (83 185 persons) of the district's total population. The total number of households in Balijana block is 15 372. The density (290.51 persons/sq. km) of population in the block is very low compared to the corresponding figure for the district (451 persons /sq. km). The percentage of scheduled caste and scheduled tribe population in the block is 5.37% and 35.12%, respectively (1991 Census). The local inhabitants in the block are mainly Rabha, Garo, Boro, Koch Rajbonshis, Yogis (Nath) and Muslim communities.

2.2.2 *Infrastructure facilities*

The infrastructural facilities in the block are not well developed with only 66 villages of the total 125 villages being electrified. The percentage of households electrified is only about 10%. Most of the villages are connected to the block headquarters at Balijana by partly fair weather and partly gravel roads. The common modes of transportation in the villages are two wheeler, autorickshaw, bullock cart and bicycle. There is also regular bus service from the block HQs to the district headquarter at Goalpara, and state capital in Guwahati. Railway tracts also pass through a portion of the block and the nearest railway stations are at Agia and Goalpara. Educational facilities available in the block ranges from primary to higher secondary schools, but lacking in basic classroom facilities (Table 2.3). There is also a college located at Agia. The local population has access to primary health centres and dispensaries.

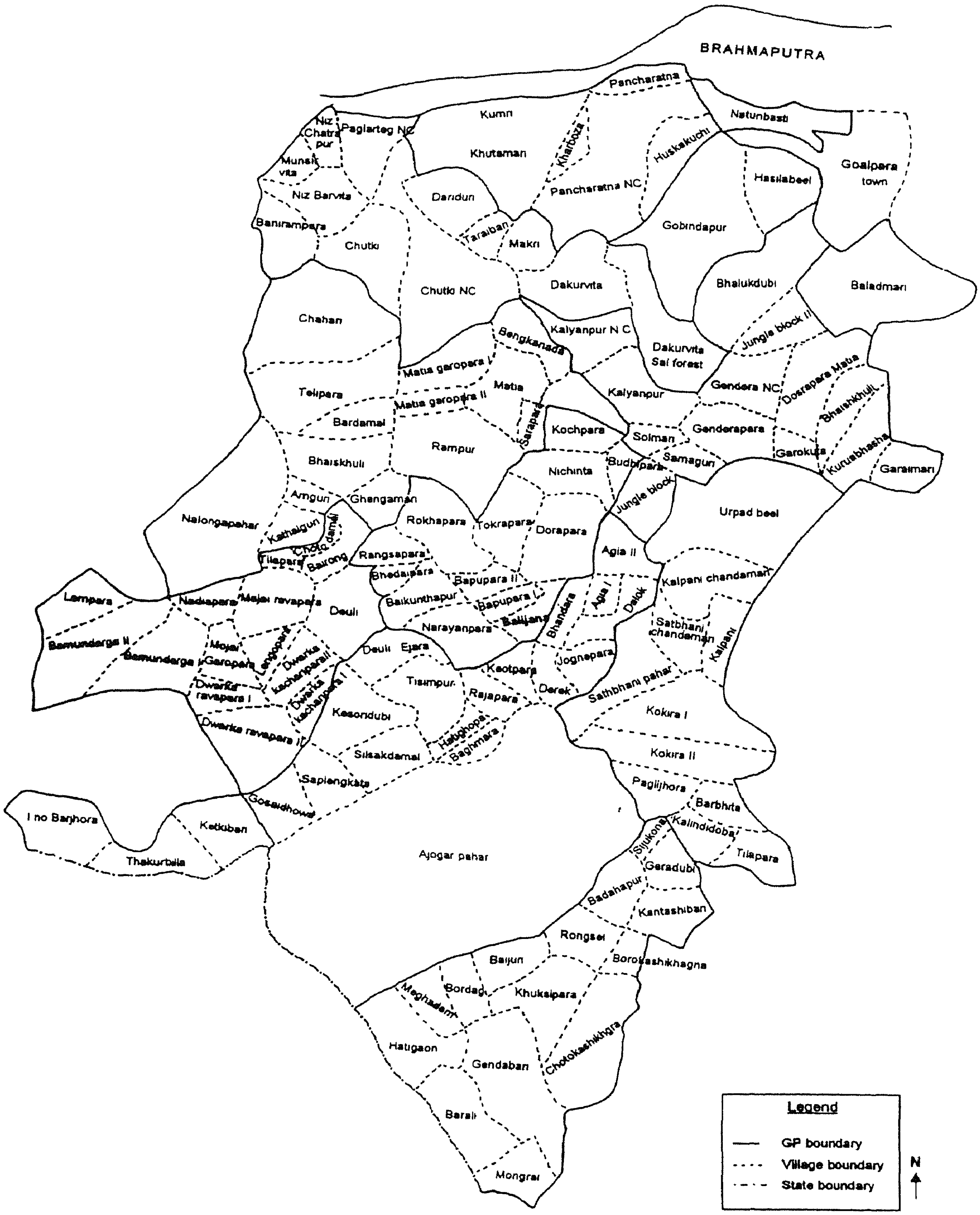


Fig 2 Distribution of villages in Balijana block

Table 2.3 Infrastructure facilities in Balijana block

Facility	Number
Schools (Primary, Middle and High)	135
Higher Secondary	9
College	1
Navodaya Vidyalaya	1
Public health centre	1
State dispensary	4
State veterinary	2
Post office (incl sub post office)	4
Bank	4

Source Block Development Office, Balijana 2001

Hand pumps, tubewell and community well/taps are the common source of drinking water. The block does not have access to any irrigation facility except a few shallow tube wells installed in some of the villages by the state agriculture department. Health facility in the block is dismal with only one PHC and four dispensary catering to the whole population. The block has only four bank branches and four post offices.

2.2.3 Land use

The block covers a total geographical area of 28 634 ha. The net-cropped area accounts for about 32% of the total geographical area. Though the State Agriculture department statistics shows the forest area to be about 20% of the total area, but according to the Forest department, about 30% of the land area is under forest cover. Off late some individuals have also started rubber plantation in the block. Almost all households in the block maintain homestead plantation in their houses.

Table 2.4 Land use pattern in Balijana block

Land use in G.P	**Area** (in ha)
Geographical area	28 634
Forest area	5 634.75
Gross cropped area	15 767
Net cropped area	9 071
Irrigated area	1 639
Barren land	1 211.05
Fallow land	553.68
Grazing land	1 264
Land under plantation (rubber)	367
Land under misc trees, groves	274.62
Homestead	1 893 7

Source Agriculture Extension Officer Agia & Bordamal Circle 2001

2.2.4 Forest pattern

The forest area of the block comes under the Goalpara Range and Krishnai Range of Goalpara Forest Division. There are both Reserve Forests (RF) and Proposed Reserve Forests (PRF) in the block. The total area under RF and PRF is 13 309.6 ha (Table 2.5). Almost half of this area falls under the villages of the neighbouring blocks, but as the forest department could not provide us data on the forest area under the respective villages of the block, so the whole area under each RF & PRF has been taken into account for calculation of the forest waste. The forest consists of different kind of trees species and bamboos but dominated by formation of Sal (*Shorea robusta*),), which cover about 60% of the total forest area and the others covering the rest 40% area. The bamboo species are Bholuka (*Bambusa balcooa*), Jati (*Bambusa tulda*) and Tarai, and the tree species are Bahera (*Terminala belarica*), Gamari (*Gmelina arborea*), Koroi (*Albizzia procera*), Makari Sal (*Schima wallichii*), Sonaru (*Cassia fistula*), Simul (*Bombax ceiba*) and Shirish (*Albizzia lebbeck*). In addition, to the RF and PRF, there is also 1 420 ha of social forestry under the Agia Social Forestry range at Balijana block. The main species grown under the social forestry plantations are Acasia, Cassia seamen, Arjun (*Terminalea arjuna*) Amlakhi (*Emblica officinalis*), Bohera (*Terminala belarica*), Teak (*Tectona grandis*), Raintree (*Samania saman*), Titasopa (*Michelia chamaka*), etc.

Table 2.5 Area under Reserve Forests and Proposed Reserve Forests

Name of RF/PRF	Area (ha)	Encroached area (ha)
Pancharatna RF	976.5	0.80
Rendu RF	245.0	125.0
Nalonga RF	838.46	07.0
Matia RF	766 80	08 0
Segunbasti RF	238.40	03 0
Rokhapara RF	195 9	08 0
Gonbina RF	117 0	10.0
Dwarka RF	181 37	07 0
Deuli RF	190.0	08.0
Gendabari RF	528.74	20.0
Geradubi RF	77.6	10.0
Ajogar hill RF	4 539.0	80.0
Baijuri PRF	79.45	-
Chikishim PRF	21.0	-
Barali PRF	65.18	-
Bogulamari PRF	1060.0	100.0
Rakhyasini PRF	2757.0	75.0
Dorni PRF	197	08.0
Khutamari Kumri hill	525	15.0
Addl to Matia	40	-
Nadiapara	161	06.0

Source Divisional Forest Officer, Goalpara 2001

2.2.5 Cropping pattern

Agriculture is the main source of livelihood in the block and mostly settled cultivation is practised. The total cropped area in the block is about 15 767 ha (Table 2.6). Principal crops of the area are paddy, oilseeds, pulses and vegetables. Maize, Wheat, Sesamum, Niger, and Jute are also grown in the block.

Table 2.6 Area under different crops in Balijana block (2000-01)

Crops	Area (ha)
Paddy	9 740.84
Rapeseed & Mustard	635
Pulses	501.1
Wheat	295.1
Maize	89.6
Sesamum	103.8
Jute	83
Spices	149.2
Niger	128.5

Source AEO Agia & Bordamal Circle 2001

2.2.6 Livestock

The major livestock in the block are cattle, goats, pigs and poultry. Pigs are mostly found in the tribal villages whereas goats are found in the Muslim and general caste Assamese villages.

Table 2.7 Livestock & poultry population in Balijana block

Type	**Numbers**
Cattle	40 308
Buffalo	614
Goat	6 432
Sheep	901
Pig	3 961
Poultry	65 696
Duck	15 571

Source Animal Husbandry & Veterinary Officer, Goalpara 2002

2.2.7 Electrification and scenario of EB substations

Fifty-six substations of various capacities (16kVA, 25 kVA, 63 kVA, 100, kVA,) have been set up for distributing power in the block (Fig 3). The Goalpara Electrical Sub division, Lakhipur Electrical Sub division and Dudhnoi Electrical Sub division under Goalpara Electrical division of Assam State Electricity Board is responsible for

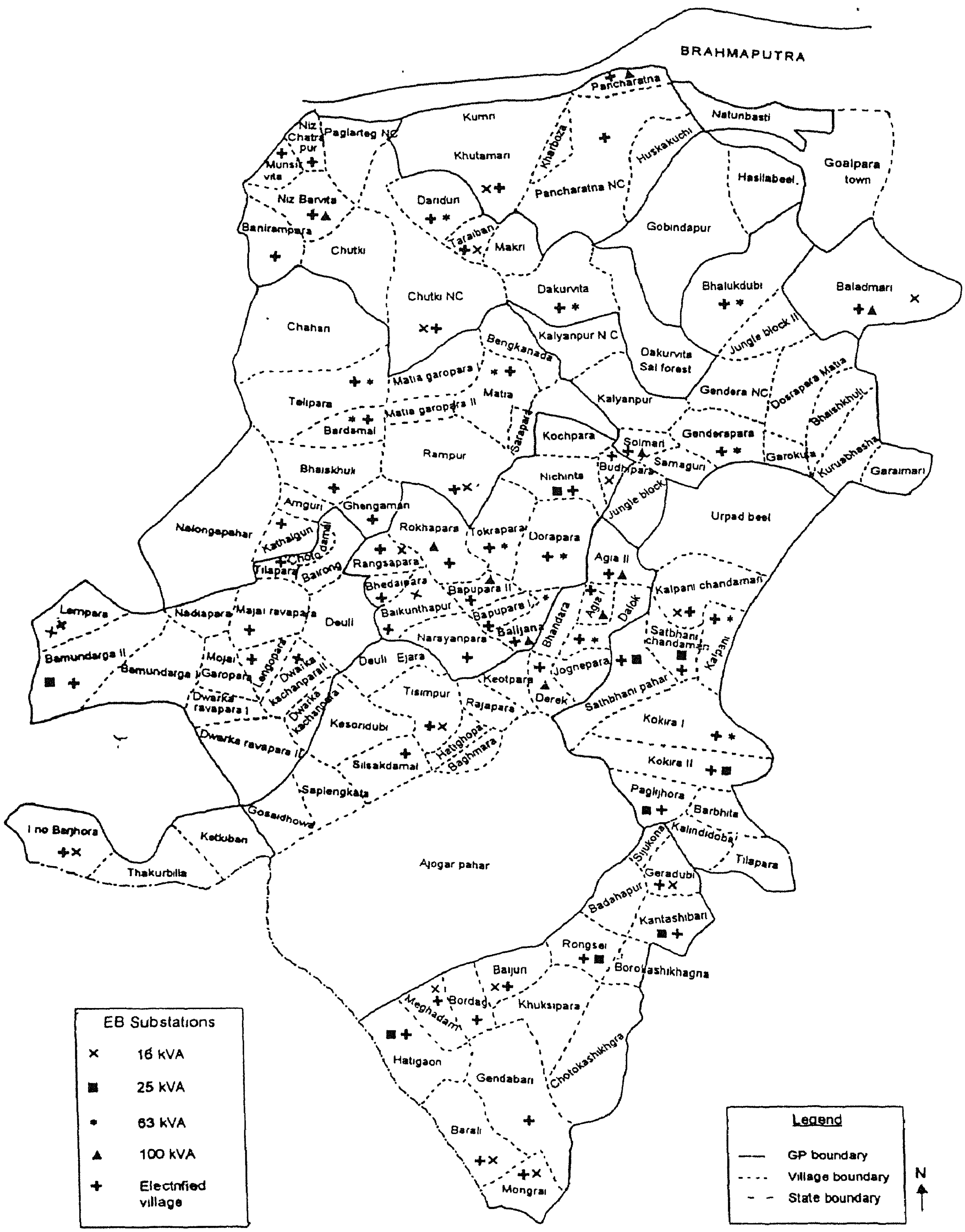


Fig 3 Distribution of electrified villages and EB substations in Balijana block

the operation and maintenance of these substations (Table2.8). There are also nine substations in eight villages (Makri,Rajapara, Kumri,Sarapara, Karuabhasha, Huskakuchi, Pancharatna NC and Bhandara) which are currently not working as informed by the ASEB, Goalpara Electrical division and also found during the primary survey.

Table 2.8 Distribution of EB substations in Balijana block

Capacity →	**16 kVA**	**25 kVA**	**63 kVA**	**100 kVA**
Villages where ASEB sub stations are located	Sijukona	Nichinta	Tokrapara	Balijana
	Dalok	Rongsei	Barvita	Baladmari
	Chandamari	Hatigaon	Bardamal	Bapupara II
	1 no Barjhora	Bapupara I	Telipara	Pancharatna
	Chutki NC	Kantashibari	Matia	Solmari
	Taraibari	Kokira II	Dakurvita	Niz Barvita
	Baijuri	Dalok	Kokira I	Agia I
	Tisimpur	Paglijhora	Kalpani	Agia II
	Meghadam	Satbhanichanamari	Dorapara	Derek
	Geradubi	Satbhani pahar	Dalok	Rokhapara
	Mongrai	Bamundarga II	Dariduri	
	Barali	Dwarka	Genderapara	
	Khutamari	Kacharipara II	Bhalukdubi	
	Rampur		Balijana	
	Budhipara			
	Baladmari			
	Bhedaipara			
	Rangsapara			
	Baikunthapur			
	Lempara			
Total	16	12	14	10

Source ASEB, Goalpara Electrical Division 2002

Chapter 3

Baseline data

3.1 Per capita annual energy consumption

Table 3.1 Per capita annual energy consumption in Balijana block

Type of fuel	Total consumption	Total population (Persons)	Per capita annual energy consumption
Firewood (t/y)	103991 15	83 185	1.25
Kerosene (lit/y)	1323182	83 185	15.91
Diesel (lit/y)	48 440.16	83 185	0.58
LPG (kg/y)	18348 82	83 185	0.22
Electricity (kWh/y)	9 82 108.2	83 185	11.81

Source Primary survey 2001-02

3.2 Domestic electricity consumption

Out of the total 125 villages in the block 66 are electrified representing 52.8 % of the total villages. Though about 53% of the villages are electrified, the percentage of households electrified is only 10%.

Table 3.2 Annual domestic electricity consumption in Balijana block

Sl. No	Village	No of households	Households electrified	Annual electricity consumption (kWh/year)
1	Baikunthapur	82	10	9399 6
2.	Balijana	220	200	201333 33
3.	Rokhapara	80	8	5200
4.	Kochpara	75	Unelectrified	-
5.	Dorapara	100	90	45000
6.	Tokrapara	79	29	29193.30
7.	Bapupara II	75	20	13000
8.	Bapupara I	200	25	20166.66
9.	Nichinta	75	20	7999
10.	Bhedaipara	32	7	3150
11.	Budhipara	65	19	6650
12.	Narayanpara	25	4	3760
13.	Rangsapara	43	4	3493
14.	Gobindapur	1606	Unelectrified	-
15.	Baladmari	154	Electrified	NA
16.	Hasilabeel	250	Unelectrified	-
17.	Natunbasti	95	Unelectrified	-
18.	Paglarteg NC	54	Unelectrified	-

19.	Niz Chatrapur	45	35	28233
20	Niz Barvita	78	60	36000
21	Makri	110	Unelectrified	-
22	Dakurvita	70	17	5950
23.	Daridun	225	15	6150
24.	Bamunghopa	86	Unelectrified	-
25.	Chutki	155	Unelectrified	-
26	Chutki NC	58	7	2870
27	Taraibari	125	8	2400
28	Banirampara	33	23	13800
29	Munsir vita	50	30	23200
30.	Bhalukdubi	1176	Electrified	NA
31.	Kalyanpur N C	83	Unelectrified	-
32.	Kalyanpur	90	Unelectrified	-
33	Dosrapara Matia	55	Unelectrified	-
34	Bhaishkhuli	100	Unelectrified	-
35	Kuruabhasha	66	Unelectrified	-
36	Garaimari	164	Unelectrified	-
37	Garokuta	33	Unelectrified	-
38	Genderapara	68	7	5180
39	Samaguri	85	Unelectrified	-
40.	Solmari	100	11	8873.33
41	Jungle block	30	Unelectrified	-
42	Kacharipara	75	Unelectrified	-
43	Baijuri	56	5	450
44	Rongsei	115	20	7000
45	Gendabari	67	4	1800
46	Khuksipara	33	Unelectrified	-
47	Kantashibari	68	4	1640
48	Meghadam	60	19	1710
49	Borokashikhagna	37	Unelectrified	-
50	Geradubi	44	6	1800
51	Mongrai	69	Electrified	NA
52.	Chorokashikhgra	172	Unelectrified	-
53.	Badahapur	93	Unelectrified	-
54	Barali	75	2	800
55	Bordak	72	6	4440
56	Hatigaon	180	3	1050
57	Sijukona	77	3	1050
58	Rampur	200	6	2400
59	Sarapara	81	Unelectrified	-
60	Metia	35	7	2870
61	Bhaiskhuli	30	5	1250
62	Kathalguri	60	5	2750
63	Telipara	232	Electrified	NA

64.	Nalongapahar	40	Unelectrified	-
65.	Bengkanada	38	Unelectrified	-
66	Bardamal	95	2	1000
67	Matia garopara I	9	Unelectrified	-
68	Matia garopara II	41	Unelectrified	-
69	Amguri	56	Unelectrified	-
70	Ghengamari	67	17	12580
71	Chahari	201	Unelectrified	-
72.	Kakuapara	57	Unelectrified	-
73	Paglijhora	91	10	3500
74.	Kalindidoba	16	Unelectrified	-
75.	Kokira I	205	Electrified	NA
76.	Barbhita	70	Unelectrified	-
77.	Tilapara	80	Unelectrified	-
78	Satbhani chanamari	220	Unelectrified	-
79	Kalpani	472	6	3900
80	Kalpani chanamari	289	13	8450
81.	Kokira II	79	7	3430
82	Sathbhani pahar	44	4	1800
83	Huskakuchi amtol	184	Unelectrified	-
84	Kharboza	49	Unelectrified	-
85	Pancharatna NC	96	Electrified	NA
86.	Pancharatna	195	192	76800
87.	Kumri	200	Unelectrified	-
88	Tilapara	127	Unelectrified	-
89	Nadia para	225	Unelectrified	-
90	Khutamari West	63	Electrified	NA
91	Khutamari East	99	Electrified	NA
92	Dwarkakacharipara I	145	Unelectrified	-
93	I no Borjhora	72	Electrified	NA
94	Choto damal	80	Unelectrified	-
95	Bairong	33	Unelectrified	-
96.	Ketkibari	115	Unelectrified	-
97.	DwarkaKacharipara II	50	8	3600
98.	Bamundarga II	178	Electrified	NA
99.	Dwarka ravapara I	70	Unelectrified	-
100	Thakurbilla	35	Unelectrified	-
101	Nadiapara	52	Unelectrified	-
102	Deuli	45	Unelectrified	-
103	Bamundarga I	119	Electrified	NA
104	Dwarka ravapara II	110	Unelectrified	-
105	Majai ravapara	104	12	9680
106.	Tilapara (Deuli)	76	7	5646.66
107	Lempara	180	Electrified	NA
108	Lengopara	76	25	20166 66

109.	Tisimpur	120	10	8066.66
110.	Kesoridubi	155	Unelectrified	-
111.	Keotpara	115	Unelectrified	-
112.	Rajapara	81	Unelectrified	-
113.	Saplengkata	140	Unelectrified	-
114.	Jognepara	125	Unelectrified	-
115.	Ajogar pahar	125	Unelectrified	-
116	Deuli Ejara	36	Unelectrified	-
117	Bhandara	170	Unelectrified	-
118.	Baghmara	85	Unelectrified	-
119	Gosaidhowa	199	Unelectrified	-
120	Hatighopa	21	Unelectrified	-
121	Silsakdamal	160	6	4305
122.	Dalok	90	30	13500
123	Agia I	120	115	108100
124.	Agia II	230	50	47000
125	Derek	126	35	32900
	Total	**15 372**	**1 293**	**8 76 436.20**

Source Primary Survey 2001-02

3.3 Village-wise energy consumption

Village wise energy consumption of various fuels was calculated based on the primary survey of the households. Fuelwood and kerosene are the main energy sources for cooking in all the villages. A few households in some of the villages near the Block HQ also consume LPG for domestic cooking.

Table: 3.3 Annual domestic fuel consumption in Balijana block

Sl No	Name of village	No of HH	Total annual fuel consumption		
			Fuel wood (t/y)	Kerosene (kl/y)	LPG(Kg)
1	Baikunthapur	82	246	6 642	252
2	Balijana	220	1232	9 900	1932.84
3	Rokhapara	80	576	6 960	-
4	Kochpara	75	236 25	3.600	-
5	Dorapara	100	285	6.600	3402
6	Tokrapara	79	584 6	6 636	840
7	Bapupara II	75	255	10 500	840
8	Bapupara I	200	720	13 800	1386
9	Nichinta	75	360	7 800	798 7
10	Bhedaipara	32	201 6	2 400	-
11	Budhipara	65	312	6.240	882
12	Narayanpara	25	202 5	1 800	-
13	Rangsapara	43	125 56	3.268	-
14	Gobindapur	1606	13716.17	199.140	-
15	Baladmari	154	1315.16	19.100	-

16	Hasilabeel	250	2500	31.000	-
17	Natunbasti	95	446 5	0	-
18	Paglarteg NC	54	324	3.564	-
19	Niz Chatrapur	45	216	3.105	NA
20	Nız Barvita	78	514 8	5.850	NA
21	Makrı	110	792	7.656	-
22	Dakurvıta	70	651	6.510	-
23	Darıduri	225	1980	18 000	-
24	Bamunghopa	86	619.2	5 504	-
25	Chutki	155	828	12.420	-
26	Chutki NC	58	417 6	4 872	-
27	Taraıbarı	125	1012 5	11 250	-
28	Banırampara	33	211 2	3.432	NA
29	Munsir vıta	50	340	5.200	NA
30	Bhalukdubı	1176	8240 85	100.445	NA
31	Kalyanpur N C	83	581 62	7 055	-
32	Kalyanpur	90	405	5.940	NA
33	Dosrapara Matia	55	297	4.455	NA
34	Bhaishkhulı	100	465	8.400	NA
35	Kuruabhasha	66	574.2	5 148	NA
36	Garaımarı	164	1377 6	13 776	-
37	Garokuta	33	272 25	2.871	-
38	Genderapara	68	530 4	6.324	-
39	Samagurı	85	637 5	11 730	-
40	Solmarı	100	840	7.600	-
41	Jungle block	30	144	1.319	-
42	Kacharıpara	75	236 25	5.175	-
43	Baıjurı	56	268 8	3 024	-
44	Rongseı	115	920	5.520	-
45	Gendabarı	67	201	4 288	-
46	Khuksıpara	33	257 4	1.683	-
47	Kantashibarı	68	217.6	4 896	-
48	Meghadam	60	175 5	5 220	-
49	Borokashıkhagna	37	202 99	3.405	-
50	Geradubı	44	211 2	3 828	-
51	Mongraı	69	378 56	6 350	-
52	Chorokashıkhgra	172	943.64	15.829	-
53	Badahapur	93	669.6	9.300	-
54	Baralı	75	930	6.000	-
55	Bordak	72	475 2	4.320	-
56	Hatıgaon	180	648	36.000	-
57	Sıjukona	77	358.05	4 158	NA
58	Rampur	200	1080	12 600	638.96
59	Sarapara	81	599.4	6.642	-
60	Metia	35	229.67	2.321	-

61	Bhaiskhuli	30	252	1.800	-
62	Kathalguri	60	432	3.360	-
63	Telipara	232	1522.39	15.379	-
64	Nalongapahar	40	262.48	2.652	-
65	Bengkanada	38	273.6	2 394	-
66	Bardamal	95	570	5 842	319 48
67	Matia garopara I	9	54	.612	-
68	Matıa garopara II	41	311 6	1.804	-
69	Amgurı	56	487.2	4.872	-
70	Ghengamarı	67	442.2	5.025	-
71	Chahari	201	1206	13.266	-
72	Kakuapara	57	427.5	3.762	-
73	Paglıjhora	91	218 4	4.368	NA
74	Kalindıdoba	16	93.56	1.183	-
75	Kokhira I	205	1198.75	15.157	-
76	Banshıta	70	409.33	5.175	-
77	Tılapara	80	648	6.480	-
78	Satbhanıchandamarı	220	1089	13 860	-
79	Kalpanı	472	2643 2	32.096	-
80	Kalpanı chandamarı	289	2037.45	29.478	NA
81	Kokıra II	79	568 8	5.214	-
82	Sathbhanıpahar	44	250.8	2.772	-
83	Huskakuchı amtol	184	1380	18.269	-
84	Kharboza	49	367.5	4.865	-
85	Pancharatna NC	96	720	9.532	-
86	Pancharatna	195	623 805	10.904	NA
87	Kumrı	200	1860	15.000	-
88	Tılapara	127	781 05	16.764	-
89	Nadıa para	225	2340	31.500	-
90	Khutamarı West	63	472 5	6 255	-
91	Khutamarı East	99	742 5	9.829	-
92	Dwarka Kacharıpara I	145	928	8.700	479.64
93	I no Barjhora	72	483 77	5 900	-
94	Choto damal	80	537 52	6 556	-
95	Bairong	33	171.6	2.376	-
96	Ketkıbarı	115	782	14.260	-
97	Dwarka Kacharıpara II	50	380	5 800	-
98	Bamundarga II	178	1195 97	14.587	-
99	Dwarka ravapara I	70	470 33	5 737	-
100	Thakurbılla	35	238	2.520	-
101	Nadıapara	52	344 76	4.836	-
102	Deulı	45	189	2 835	-
103	Bamundarga I	119	799 56	9 752	-
104	Dwarka ravapara II	110	739 09	9 015	-
105	Majaı ravapara	104	977.6	8.320	-

106	Tilapara (Deuli)	76	421 8	5.472	-
107	Lempara	180	1209.4	14.751	-
108	Lengopara	76	478.8	4.788	-
109	Tisimpur	120	816	15.360	-
110	Kesoridubi	155	1116	10.695	-
111	Keotpara	115	724 5	11 385	-
112	Rajapara	81	704 7	5.589	-
113	Saplengkata	140	1372	14.000	-
114	Jognepara	125	900	13 500	-
115	Ajogar pahar	125	562 5	7 500	-
116	Deuli Ejara	36	244 8	4 464	-
117	Bhandara	170	1224	11 220	-
118	Baghmara	85	586 5	5.100	-
119	Gosaidhowa	199	1253 7	15.522	-
120	Hatighopa	21	134 379	1 343	-
121	Silsakdamal	160	960	9 600	NA
122	Dalok	90	283 5	8 370	3696
123	Agia I	120	547 2	7 200	1075 2
124	Agia II	230	0	10 350	1638
125	Derek	126	869 4	7 938	168
	Total	**15 372**	**1 01 920.9**	**1 323.182**	**18 348.82**

Source Primary survey 2001-02

3.4 Industry level energy consumption

The industrial activity in the block is restricted to some small rice mill of capacities 4 HP, 5 HP, 8 HP and 10 HP, of which about 80% are of the lower capacities There are also 2-floor mills, 3-Oil mills and a spice mill in the block.

Table 3.4 Annual industrial energy consumption in Balijana block

Type	No of units	No of surveyed units	Average Annual Consumption per unit		Total Annual Consumption	
			Diesel(lit)	Elect(kWh)	Diesel(lit)	Elect(kWh)
Small rice mill	120	64	448 52	8 806	48 440.16	105 672
Flour mill	2	1	NA	NA	NA	NA
Oil/spice mill	4	2	NA	NA	NA	NA

Source Primary survey 2001-02

Note: About 10% of the total rice mill (mostly 10HP) run on electricity and the rest run on diesel

3.5 Energy consumption of commercial activities/public utilities, agricultural activities and other misc. activities

Table 3.5 Annual energy consumption of commercial activities

Type of establishment	No of units	No of surveyed units	Average annual consumption per unit			Total annual consumption		
			FW (ton)	Kero (lit)	Elect (kWh)	FW (ton)	Kero* (lit)	Elect* (kWh)
Restaurant	169	11	12.25	350	10.50	2070 25	-	-
Public utilities	NA	-	-	-	NA	-	-	NA

Source Primary survey 2001-02

* As the number of restaurants consuming kerosene and electricity was found to be only one out of the 11 surveyed units, so the total annual consumption of kerosene and electricity was not ascertained, because of the small sample size

Chapter 4

Biomass generation as per land area classification

4.1 Biomass from forests

Balijana block comprises 10 *Gaon Panchayats* (GP) covering an area of 28 634ha. The study block has about 14 729 6 ha forest cover consisting of Reserve Forests, Proposed Reserve Forests and Social Forestry The annual sustainable wood production from such plantations is 53 684 53 tonne and grass yield is 17 746 13 tonnes/year (Table 4 1).

Table 4.1 Biomass generation from forests

Land type	Area (ha)	Area (ha)	Productivity[1] (ton/ha)	Annual yield (ton/ha/year)	Total annual yield (t/year)
Forests		Sal 7 985.76	130 06	3 46	27 630.73
(RF & PRF)	13309 6	Misc 5 323 84	103 67	2.76	14 693.80
		Grass 13 309 6	2	1 33	17 746 13
Social forestry	1 420	1 420	-	8[2]	11 360 00

Source Divisional Forest Officer (Territorial and Social Forestry), Goalpara 2001

Note. The forests comprise of 60% Sal formation and the rest 40% consist of miscellaneous trees as informed by the Range Officer of Goalpara and Krishnai Ranges

Rotation age of tress in RF and PRF has been considered to be 75 years Sustainable grass yield is taken as 2/3[rd] of the total generation as it may not be possible to harvest grass from all the forestland

4.2 Biomass from homesteads

Homesteads plantation consists of additional source of biomass fuels. The vegetation composition of the homestead include fruit trees such as *jackfruit, mango, guava, banana, betelnut, coconut, etc*, bamboo and shrubs. Maintenance of bamboo in homestead garden is to ensure an uninterrupted bamboo supply both for fuelwood and construction activities. During the primary survey it was found that out of the total area under homesteads, about 60% -70% is trees and remaining 30% - 40% is bamboo grooves. The annual sustainable biomass production from homestead is 397.68 tonnes.

Table 4.2 Biomass generation from homesteads

Land type	Biomass type	Area (ha)	Productivity[3] (t/ha)	Annual yield[3] (t/ha/y)	Total annual yield (t/y)
Homestead	Woody	1 893 7	8 4	0.21	397.68

Source Agriculture Extension Officer, Agia and Bordamal Circle 2002

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1 Forest Survey of India 1996

2 FAO-RWEDP 2001

3 Hazarika N, Agarwal S et al 1997

4.3 Biomass from grazing lands, cultivable waste land and others

The biomass available in grazing land, fallow land, barren lands, and misc. lands etc. is usually grass and shrubs with some trees. Such lands are scattered and are not restricted to any area in the block. The annual sustainable yield of woody biomass from such lands is 757.95 ton and total grass yield is 2 726.52 tonnes (Table 4.3).

Table 4.3 Biomass generation from miscellaneous lands

Land type	Area (ha)	Biomass type	Productivity[4] (t/ha/yr)	Annual Yield (t/y)
Barren land	1 211.05	Shrubs	-	-
Fallow land	553 68	Grass	1.5	830.52
Land under misc trees	274.62	woody	2.76[1]	757 95
Grazing land	1 264	Grass	1.5	1 896

Source Agriculture Extension Officer, Agia and Bordamal Circle 2002

4.4 Biomass from agriculture land

Paddy is the major agricultural crop of Balijana and covers an area of 9 740.84 ha It accounts for 61.78% of the block's gross cropped area. Other crops grown include wheat, maize, mustard & rapeseed, pulses, jute, sesamum, spices, and vegetables. Based on the cultivation area under respective crops, only field crops such as paddy, pulses, wheat, maize, rapeseed and mustard, sessamum and jute are taken into account, as the production of other crops is not so substantial. The total annual agricultural residue generated from paddy is 50 336.25 tonnes and from minor crops is 3 277.21 tonnes.

Table 4.4 Residue generation from major crop (2000 - 01)

Crop	Season	Production (t/y)	Total Production (t/y)	Type of residue	RPR [5]	Residue production (t/y)
Paddy	Summer	4 670.39	24 832.88	Straw	1.76	43 705.87
	Winter	16 247.00				
	Autumn	3 915.49		Husk	0.267	6 630.38

Source Agriculture Extension Officer, Agia and Bordamal Circle 2002

Table 4.5 Residue generation from minor crops (2000 - 01)

Crop	Production (t/y)	Type of residue	RPR	Residue production (t/y)
Rapeseed & Mustard	355.05	Stick	2.5 [5]	887.63
Pulses	377.5	Stalk	2.5 [5]	943 75
Wheat	433.77	Straw	1.75 [5]	759.10
Maize	200.04	Stalk	2.00 [5]	400.08
Sessamum	36.59	Leaves & branches	1.3 [6]	47.58
Jute	159.38	Stick	1.5 [6]	239.07

Source Agriculture Extension Officer, Agia and Bordamal Circle 2002

[4] Forest Survey of India 1996

[5] Baruah D C, Jain A K 1998

[6] School of Energy Studies Jadavpur University 2001

Chapter 5
Biomass scenario in industries

5.1 Biomass generating industries

There are no large-scale biomass generating industries in the block However, the small-scale rice mills, flour mills and oil expelling units comprise a source of biomass (residue) supply as a by-product of processing agricultural crops (Table 5.1).

Table 5.1 Type and distribution of biomass generating industries

Industry	Units	Location (no of units)	Type and amount of residue generated
Rice mill	120	Balijana(2), Kochpara(1), Dorapara(2), Tokrapara(2) Bapupara II(2), Bapupara I(1), Nichinta(2), Bhedaipara(1), Budhipara(1), Narayanpara(1), Niz Barvita(1), Dakurvita(1), Daridurí(3), Bamunghopa(1) Chutki(4),Chutki NC(3), Banirampara(1), Munsir Vita(1), Bhalukdubi(1), Kalyanpur(1), Bhaishkhuli(2), Kuruabhasha(2) Garaimari(1), Garokuta(1), Genderapara(1), Solmari(4), Baijuri(4), Rongsei(6), Gendabari(3), Kantashibari(2), Meghadam(1), Badahapur(2), Barali(3), Bordak(2), Hatigaon(2), Sijukona(2), Rampur(3), Sarapara(2), Metia(1), Bhaishkhuli(3), Kathalguri(1), Bardamal(3), Ghengamari(1), Chahari(2), Kakuapara(1), Paglijhora(3), Tilapara(1), Kokira(4), Satbhani pahar(1), Kumri(1), Ketkibari(2), Thakurbilla(1), Nadiapara(2), Majai ravapara(2), Tilapara(Deuli)(3), Lengopara(3), Tisimpur(2), Rajapara(1), Ajogar pahar(1), Bhandara(1), Gosaidhowa(2), Hatighopa(1), Silsak damal(1), Dalok(1)	Hull 538.032 t/y
Oil/spice mill	4	Balijana(1), Nichinta(1), Kuruabhasha(1), Gendabari(1)	NA
Flour: mill	2	Balijana(1), Banirampara(1)	NA

Source Primary survey 2001-02

5.2 Biomass generation and consumption industries

There exists no industrial units in the block which generate and consume biomass as an energy source. The industries listed in table 5.1 consume biomass as raw material and generate biomass (residues), which could be used for various purposes..

5.3 Biomass consuming industries

There are no biomass consuming industries in the block. Restaurants and hotels are the main commercial consumer of woody biomass in the block. These are spread almost in all the Gaon panchayats with Balijana and Agia GP accounting for majority of them.

Table 5.2 Types and distribution of biomass consuming industries

Commercial establishment	Units	Location (No of units)	Amount of biomass consumed
Restaurant & hotels	169	Balijana GP (13), Baladmari GP (5), Dariduri GP (13), Kalyanpur GP (22), Kumri GP (11), Kalpani Chandamari GP (21), Agia GP (16), Bardamal GP (30), Dwarka GP (19), Badahapur GP (19),	Firewood: 2 070.25 t/y

Source Primary survey 2001-02

Chapter 6

Biomass consumption and surplus availability

6.1 Land

6.1.1 Surplus biomass from different land categories

Table 6.1 Consumption and surplus availability of woody biomass, grass and shrubs

Type of biomass	Land type	Generation (t/y)	Total (t/y)	Consumption (t/y) Fuel	Fodder	Others	Surplus/ (Deficit) t/y
Woody biomass	RF & PRF	42 324 53	54 840.16	103 991.15	-	-	(– 49 150.99)
	Social forestry	11 360					
	Homestead	397 68					
	Misc. trees	757 95					
Grass[1]	Grazing land	1 896	20 472 65	-	20 472 65	-	Nil
	Fallow land	830 52					
	Forest	17 746 13					

Source Table 4 1, Table 4 2 and Table 4 3, Primary survey 2001-02

Note [1]There is an chronic shortage of grass as informed by the villagers during the primary survey, thus the entire grass production has been estimated to be utilised as fodder.

6.1.2 Surplus biomass from agriculture

Table 6.2 Consumption and surplus availability of crop residues from cultivable land

Residue type	Generation (t/y)	Consumption (t/y) Fodder	Fuel	Manure	Thatching	*Surplus (Deficit) t/y*
Paddy						
Straw	43 705.87	51 580 56	-	1 215 6	1 334.4	(– 10 424.69)
Husk[2]	6 630.38	6 630.38	-	-	-	Nil
Mustard stick	887 63	-	-	-	-	887 63
Pulses stalk	943.75	1 008	-	-	-	(– 64.25)
Wheat straw	759 10	2 4	-	-	-	756.7
Maize stalk	400.08	-	-	-	-	400.08
Sesamum leaves	47 58	-	-	-	-	47.58
Jute stick	239.07	-	1.2	-	-	237.87

Source Table 4.4 & Table 4 5, Primary survey 2001-02

Note [2] There is no surplus husk/hull availability in the villages of the block as informed by the villagers in the FGD conducted during primary survey and all hull that is generated either manually or in the rice mills are locally consumed in the block as cattlefeed.

6.2 Industries

There are 126 biomass-generating units, out of which 120 units are small sized rice mills, 3 are oil mills, 2-flour mills and 1 spice mill. There are 169 small restaurants and hotels, which consume biomass in form of wood, and buy their supplies from the local market at the rate of Rs 100 - 150/quintal

6.2.1 Surplus agro residues from biomass generating industries

Table 6.3 Surplus agro residues from biomass generating industries

Industry type	Units	Generation t/y	Utilization t/y	Surplus t/y	End use
Rice mill	120	538 03	538 03	Nil	Cattle & poultry feed
Flour mill	2	-	-	-	-
Oil/spice mill	4	-	-	-	-
Total	126	538 03	-	-	-

Source Table 5 1, Primary survey 2001-02

6.3 Summary table

Table 6.4 Status on surplus availability of biomass in Balijana block

Type of biomass	Generation	Consumption t/y				Surplus
	t/y	Fodder	Fuel	Manure	Thatching	(deficit) t/y
Woody biomass (forest wood, jute stick and mustard stick)	55 966 83	-	103 992 35	-	-	(– 48 025 52)
Leafy biomass (grass, paddy, pulses & wheat straw, sessamum leaves)	66 329.03	73 063.61	-	1 215 6	1 334 4	(– 9 284 58)
Powdery biomass (paddy husk/hull)	6 630.38	6 630 38	-	-	-	Nil

Chapter 7

Surplus biomass availability

7.1 Woody biomass

The annual sustainable yield of woody biomass from forests, homesteads and miscellaneous lands is far below the consumption levels, leading to a chronic deficit of wood availability in the block. This has resulted in large scale felling of trees in the block for use as fuelwood It was observed during the primary survey that the tribal villagers residing near the forests cut firewood from the forests and sell the same @ Rs1.0 – 1 5/- per kg to the villagers who reside away from the forests. Thus there is no surplus woody biomass available in the block to sustain the operation of gasifier based power generating facilities.

7.2 Agricultural biomass

Net cropped area accounts for 9 071 ha (31 68%) of the block's total geographical area of 28 634 ha. Field crops such as paddy (*Sali, Ahu, Boro*), wheat, maize, rapeseed and mustard, pulses (black gram, green gram, arhar, lentil), sesamum, jute, are grown in different seasons In addition, spices and vegetables are also grown. Of all the field crops, *Sali* paddy (winter paddy) comprises primary crop covering an area of 6437 84 ha followed by *Ahu* (2 027 ha) and *Boro* paddy (1 276 ha). Total annual production of *Sali* paddy during the year 2000-01 was 16 247 ton, *Ahu* 3 915.49 ton and *Boro* 4 670.39 ton. The total residue generation from paddy during different periods of the year is 50 336.25 ton, of which 43 705 87 ton is straw and 6 630.38 ton is husk and hull (Table 7.1). Out of the total residue generated, almost 95% is utilised as feedstock, 2.5% is utilised as organic fertiliser and the rest for thatching. The hull, which is generated during dehusking, is totally consumed for feeding cattle and pigs. Thus the block has to import cattle feed from the neighbouring blocks

A number of field crops such as rapeseed, mustard, pulses, sesamum, jute, wheat, maize, niger, etc are also grown as minor crops. Out of these crops, pulses, rapeseed and mustard, sesamum, wheat, and jute are found to be favoured for cultivation by the farmers, and occupy an area of 1 707.6 ha. Considering these crops as the dominant minor crops, the total annual residue generated is 3 277.21 tonnes (Table 7.2). Minor crop residues do not have any commercial value and are consumed as fuel and fodder as like paddy residue.

Table 7.1 Residue generated from major crops (2000-01)

Paddy	Harvesting season	Area(ha)	Production t/y	RPR	Residue t/y	Surplus t/y
Summer (*Boro*)	April-May	1276	4670.39	Husk· 0.267 Straw: 1.76	Husk: 1246 99 Straw: 8219.89	Nil
Winter (*Sali*)	Nov. - Dec	6437.84	16247		Husk: 4337.95 Straw. 28594.72	Nil
Autumn (*Ahu*)	June-July	2027	3915.49		Husk: 1045.44 Straw: 6891.26	Nil
Total		**9 740.84**	**24 832.88**		**Husk: 6 630.38** **Straw: 43 705.87**	**Nil**

Source Agriculture Extension Officer, Agia and Bordamal Circle 2001

Table 7.2 Residue generated from minor crops (2000-01)

Minor crops	Harvesting season	Area ha	Production t/y	RPR	Residue t/y	Surplus t/y
Rapeseed & Mustard	Jan-Feb.	635	355.05	2.5	887.63	887.63
Pulses	Nov-Dec.	501.1	377.5	2.5	943.75	(– 64.25)
Wheat	Mar-Apr	295 1	433 77	1.75	759.10	756.7
Maize	June - Aug	89 6	200.04	2.00	400.08	400.08
Sessamum	Nov	103.8	36.59	1.3	47 58	47.58
Jute	July – Aug	83	159.38	1 5	239 07	237 87
Total	-	**1 707.6**	**1 562.33**	-	**3 277.21**	**2 265.61**

Source Agriculture Extension Officer, Agia and Bordamal Circle 2001

7.2 Industrial biomass

The industrial base in Balijana is restricted to small-scale establishments such as rice mills, and few flourmills, and oil mills. The rice mills comprise the major biomass generating industries. These consume paddy as raw material, and generate hull as residues. The farmers come with their paddy for milling and after processing, both rice and hull are taken back by the farmers. The hull is then used for feeding cattle and pigs. Some amount of hull remains in the mill, which is sold by the mill owners @ Rs 6-10/- per tin (Rs 0.80–Rs1.2/ kg) for utilisation as feed for the cattle and pigs. The flourmills consume biomass (wheat grain) but do not generate biomass residue. Thus currently there is no surplus availability of rice husk in the block (Table 7.3)

Table 7.3 Biomass generating industrial units in Balijana block

Industry type	No units	Type of residue	Residue generation* (t/y)	Available surplus (t/y)
Rice mills	120	Hull	538 03	Nil
Oil/spice mills	4	Oil cake	NA	NA
Flour mill	2	-	NA	NA
Total	**126**		**538.03**	**Nil**

Source Primary survey, 2001

Note * Residue generation is estimated on the basis of hull left behind at the mill by the farmers, which is about 10% of the total hull generation. The rest are taken away by the farmers for self-consumption.

Chapter 8

Biomass collecting mechanism and management

8.1 Seasonal availability and cost

Forest based woody biomass is the major source for energy related activity at the household and commercial (restaurant) level within the block. The current wood based biomass scenario for the block represents a glum picture (refer to Table 6.1). For households residing near the forests, firewood are obtained at zero cash outlay, but households in the peri urban area or residing far from the forests buy wood at Rs 100-150 /quintal. Large-scale commercial trading in wood is not prevalent in the block. The social forestry plantations raised by the Forest Department are for community use but with access vesting with the Department Thus there is no commercial value attached to it at present. The biomass from grazing lands, fallow lands, etc. are available almost through the year with free access to the resources.

Other than the forest based biomass, agricultural residues generated from major and minor crops constitutes about 53 613 46 ton anually. Paddy constitutes the major crop with three types (*Ahu, Sali, Boro*) being cultivated in the block Minor crops include cereals (wheat & maize) oilseeds (mustard & rapeseed, sesamum), Pulses (black gram, green gram, arhar, lentil etc) jute and vegetables Harvesting of major and minor crops and the collection of crop residues is seasonal activity, handled by the farmers themselves. While collection and storage of straw (paddy as well as minor crops) is carried out at the household level, dehusking of paddy is undertaken at the local rice mills (120 nos) throughout the year. Paddy straw stored at the household level is used as feedstock, organic matter and thatching. Local trading in straw is also prevalent but in very low scale @ Rs 120- Rs 200 per quintal and is generally traded within 5-12 km radius of respective villages. However, paddy husk and hull generation is concentrated in rice mills, as almost all households prefer to get the paddy processed at the local rice mills The milling rate charged by the rice mill varies between Rs 20/- to Rs 30/- per quintal of paddy. The farmers come with their paddy for milling and after processing, both rice and hull are taken back by them for use as cattle and pig feed. The farmers who don't have enough livestock leave behind the hull at the mill which is then sold by the mill owner @ Rs 6-10/- per tin (Rs 0.80 – Rs1.2 per kg).

Minor crops selected for contribution to biomass production is based on the area under cultivation and production. In the present study, rapeseed and mustard, pulses, wheat, maize, jute and sesamum have been considered. The biomass availability from these crops is restricted to eight months in the year (February to August, and November-December), but in very small quantity. Owing to the low production of such crops and

the associated use of the crop residues generated for fuel and fodder by the households; there is no commercial trading in residues from minor crops.

Thus the total crop residue generated is totally utilised as feedstock, organic matter and thatching. Therefore no surplus amount of agricultural residue is available in the block for power generation.

Table 8.1 Seasonal availability of biomass and pricing in Balijana block

Crop	Harvest season	Quarter	Hull price (Rs/ton)	Straw price (Rs/ton)
Paddy				
Boro	April-May	Jan.- March	Rs 1200	Rs 1 500
Ahu	June-July	April-June	Rs 800	Rs 1 300
Sali	Nov - Dec	Oct.- Dec	Rs 800	Rs 1 300
Rapeseed & Mustard	Feb -March	No commercial trading exists in residues of these crops.		
Pulses	Nov - Dec			
Wheat	March - April			
Maize	June - Aug			
Sesamum	November			
Jute	July - Aug			
Fuelwood	All year round	All quarters	Rs 120-200/ quintal	
Grass & shrubs	All year round	All quarters	Zero cost	

Source: Primary Survey 2001-02

8.2 Transportation of biomass

The communication network in Balijana comprises a network of metalled, fair- weather and motorable roads connecting all the villages to the block headquarters. Most villages are located within a distance of about 20-km radius of the block headquarters, and are inter-connected mostly by surface and gravelled road. Only the villages near the block HQ are connected by metalled roads. Generally farmers transport the paddy from the fields to their respective houses on bullock cart or on headloads. Based on the demand for processing, paddy is transported to the milling centres on bicycle or handcarts/bullock carts. Thereafter the grain and hull are usually transported within and outside the village by bicycles, bullock carts and handcarts. The same mode of transportation also applies for minor crops. Almost every household in the village possesses a bicycle. Handcarts can be hired at the rates ranging from Rs 20 to Rs 60 for a full load of 180 kg for a distance of 3 to 10 km.

Table 8.2 Overview of road connectivity in Balijana block

Connecting road	Metal km	Gravel km	Total km
1 Kalyanpur Makri Road	-	4 76	4 76
2 Cremation ground road	-	2 6	2.6
3 Maldhana Bamundanga Road	-	0 35	0 35
4 Bordamal Karaikhowa Road	-	0 5	0 5
5 Makri Maldhana Road	-	16 33	16 33
6 Bapupara to Bordamal Road	3 10	-	3.10
7 Solmari Mojonga via Dalok	-	4 43	4 43
8 Karbala to Gobindapur Road	0 73	-	0 73
9 Balijana Damal Barjhora	0 57	-	0 57
10 Matia Simlitola Road	12 818	1 644	14 462

Source PWD (Roads) department, Goalpara

Chapter 9

Biomass consuming industries

9.1 Biomass consuming industries

The Balijana is industrially backward and as such there is no major industry in the block There are about 44 registered small-scale units, which are scattered all over the block Small sized rice mills are found in all the Gaon panchayats in the block numbering 120 mills There are also 3 Oil mills, 2 flour mills and a spices unit in the block The rice and oil mills consume biomass (paddy and oilseeds) as raw material only and do not use biomass as fuel Therefore, there is no direct use of biomass resources (as energy source) by the local industrial units Table 9 1 presents the distribution of industries in the block

Table 9.1 Distribution of industries in Balijana block

Industry	No of Units	Location (no of villages)	
Rice mills	120	64	
Oil mills	3	3	For details refer Table 5 1
Flour mills	2	2	
Spice mill	1	1	

Source Primary survey 2001

Even though biomass consuming industries are absent in the block, other establishments that consume biomass are the restaurants and tea stalls located in the villages About 169 small restaurants, mostly tea stalls, are found in the block. Such units consume an average of 35 kg of firewood daily or 12 25 ton annually The total annual firewood consumption by these units is 2070 25 ton The required fuelwood is procured from the local market at the rate of Rs 120-200/quintal Generally, these units burn the fuelwood in mud cookstoves The use of improved cookstoves in such establishments would help in reduction of the firewood consumption by about 20-25% resulting in considerable firewood savings annually However, field trials on energy savings from improved cookstoves at individual level are yet to be undertaken in the block Thus energy savings cannot be computed based on assumptions

Chapter 10

Possible power generation potential & economics

The current annual domestic electricity consumption in Balijana is 8 76 436.20 kWh. (Primary survey 2001-02). If all the households in the block were to be electrified, then the annual domestic electricity demand *(based on the current average monthly consumption of 56 units per household)* in the block would be 10 419 626 kWh Thus the demand is a whopping 12 times the current consumption Among the various sectors, domestic sector is the largest consumer followed by commercial sector, and public utilities Currently the power supply is coming from the generating stations located outside the block It is envisaged that with the expansion of the grid network there will be a rise in the domestic demand for power in future At present, the Assam State Electricity Board does not have any plans to electrify the unelectrified villages (47%), which implies that there is potential for renewable energy technology interventions for rural electrification Thus an alternative option for supplying power is by generating power through decentralised renewable energy technologies (biomass gasifier, solar photovoltaic etc) particularly at the village-level or through centralised power generating units connected to the existing grid

10.1 Power generation potential

Given the biomass resources assessed and their utilisation in the study block, woody biomass and agricultural residues do not have the potential to support biomass based power generation units. This is based on inferences drawn from information obtained during primary survey and later corroborated through analysis of secondary information rendering to a deficit of 48 025.52 t/y woody biomass, 9 284 58 t/y of leafy biomass and no surplus powdery biomass. ***Hence, the present assessment study does not yield an over all feasibility for biomass based power generation in the Balijana block.***

Chapter 11

Recommendations and proposals

The biomass resources available in the block are in the form of wood and agriculture residue. Woody biomass is currently used for domestic cooking and in restaurants and small hotels whereas crop residues are utilized mostly as feedstock and some quantity for manuring and thatching. The current energy consumption scenario revealed that domestic sector is the major consumer with low power demand. Industrial power demand is insignificant in the absence of any large-scale industries except for small-scale units like rice/wheat mills

The consumption pattern of woody biomass as well as crop residues in Balijana block, with the consumption exceeding the sustainable yield, leaves no scope to support a power generation unit based on any surplus biomass residue. Thus it is recommended to take up plantations of fast growing tree species in the block for catering to the fuelwood demand in the block This is expected to reduce the indiscriminate cutting of trees for fuelwood and would also save the valuable *Sal* formations found in the block Village forests should be developed by planting fuelwood species in the community lands or in the degraded forests and the maintenance such plantations should be vested with the community. During the primary survey, it was found that in some tribal villages, the community has collectively decided to stop rearing of goats as it destroys their standing crops. Such villages may be motivated to develop community forests as community action is already in existence In addition, improved cookstoves may be disseminated in large numbers to conserve the forests These measures will on the one hand decrease the fuelwood consumption and simultaneously increase the forest yield

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Annex 1

Survey schedule

Biomass Assessment for Power Generation in Balijana Block, Goalpara district, Assam

VILLAGE SURVEY SCHEDULE

General information

1. Village Name:______________ 2. Geographical Area________ Ha

3. No. of Households _____ 4. Population____ 5. Major ethnic group_________

6. Type of connecting road: metalled/foot track/motorable (unmetalled)

Electrification

7. Village Electrified (Yes/No)

8. If yes number of households electrified _________

9. Source of electrification: Grid/Diesel Gen sets (capacity): kVA

10. Average no of hours power is available per day: ________hrs/day

11. Types of connections

Types	Number	Average load per type
Domestic		
Agriculture		
Commercial		
Industries		
Public utilities		
Government institutions		
Others		

12. Electricity tariff : Billing/Flat rate

13. Average rate : _______Rs/month

Land details

14. Land Area (in bigha/ acres)

Total cropped area	
Net irrigated area	
Gross irrigated area	
Forest area	
Area not available for cultivation	
Fallow land	
Grazing land	
Other uncultivated land excl fallow land	
Land under Non Agricultural uses	

15.Land ownership

Land category	Number of households	Average income per household
Large (> 75 bigha)		
Medium (30 - 75 bigha)		
Semi medium (15 – 30 bigha)		
Small (7.5- 15 bigha)		
Marginal (< 7.5 bigha)		
Landless		

16. Availability of biomass

Crops grown	Area (bigha)	Yield (mon/bigha)	Total production (qtl/year)	Type of Agri residue
Paddy				1. 2.
				1. 2.
				1. 2.
				1. 2.
				1. 2.
				1. 2

17. Livestock details

Cattle	Buffalow	Goat/sheep	Pigs	Poultry	Others

18. Irrigation details

No of canals Govt. & Private	
Area irrigated by canal (bigha)	
No of tanks	
Area irrigated by tanks (bigha)	
No of wells	
Area irrigated by wells (bigha)	
No of Borewells	
Area irrigated by borewells (bigha)	
No of lift irrigation projects	
Area irrigated by lift irrigation (bigha)	
Other sources – Name	
Area irrigated by other sources (bigha)	

19. Small industries

Industry	Number
Flour mill	
Rice mill	
Saw mill	
Oil mill	
Others	

20. Collection of wood

Season of collection	Source	Access (right to) for
Summer		
Winter		
Monsoon		

Access: fuel/fodder/small timber/timber

Biomass utilisation

21. Availability of biomass

Is biomass available?	Yes/No
Whether household sell biomass	Yes/No
To whom and at what rate?	
No. of times households sell biomass per year	
Place of storage	
Transportation arrangement	
Cost of transport	

22. Consumption of biomass

Crop	Crop residue	Biomass utilization qtl/year						Total qtl/year
		Fuel	Fodder	Roofing	Fertilizer	Mulching	Others	
	1. 2.							
	1. 2.							
	1. 2.							
	1. 2.							

Additional Remarks of the surveyor (if any)

Biomass Assessment for Power Generation in Balijana Block, Goalpara district,

Household Level Schedule

Household details

HH No	Name of respondent	Village	No. of family members			Primary occupations	Secondary occupations	Average monthly income * (Rs)	Type of house Pucca/katcha
			M	F	C<15				

* Write BPL if less than Rs 400/-, LIG if between Rs 400/- to 1500/-, MIG if 1500/- t0 3000/- & HIG if > 3000/-

Resources

HH No	Land owned (in acres)						Means of Irrigation	Livestock details					
	Total	Cropped	Homestead	Irrigated	Fallow	other		Cattle	Goat	Buffalo	pigs	Poultry	others
1.													
2.													
3.													
4.													
5.													
6.													

Biomass generation

HH No.	Crops grown	Area (bigha)	Yield (mon/bigha)	Total production (mon/year)	Type of residue	Amount of reside generated
1.	1.Paddy: 2. Oilseeds: 3. Pulses: 4. Vegetables: 5. others					
2.	1.Paddy: 2. Oilseeds: 3. Pulses: 4. Vegetables: 5. others					
3.	1.Paddy: 2. Oilseeds: 3. Pulses: 4. Vegetables: 5. others					
4.	1.Paddy: 2. Oilseeds: 3. Pulses: 4. Vegetables: 5. others					
5.	1.Paddy: 2. Oilseeds: 3. Pulses: 4. Vegetables: 5. others					
6.	1.Paddy: 2. Oilseeds: 3. Pulses: 4. Vegetables: 5. others					

Biomass consumption

HH No.	Type of residue	Biomass utilization							
		Fuel	Fodder	Roofing	Manure	Burnt in field	Mulching	Sold	Total
1.	Crop residue Woddy biomass Others								
2.	Crop residue Woddy biomass Others								
3.	Crop residue Woddy biomass Others								
4.	Crop residue Woddy biomass Others								
5.	Crop residue Forest residue Others								
6.	Crop residue Forest residue Others								

Energy Consumption Pattern

HH No	Cooking (per month)					Lighting / others (per month)		
	Fire wood (kg)	Crop residue (Kg)	Dung cake (Kg)	Kerosene (litre)	LPG (cyl)	Electricity (unit)	Kerosene (litre)	Others
1.								
2.								
3.								
4.								
5.								
6.								

Biomass Assessment Study in Balijana block, Goalpara district, Assam

SURVEY SHEET FOR COMMERCIAL/INDUSTRIAL ESTABLISHMENTS

Industry/commercial level energy consumption

Name of industry/ commercial establishment	Type & capacity	Village	Fuel consumption per month						
			Diesel (lt)	Electricity (unit)	Crop residue (Kg)	Firewood (kg)	Coal (kg)	Kerosene (lt)	LPG (cyl)

Biomass generation by industries/commercial establishments

Name of industry/ commercial establishment	Type & capacity	Village	Type & amount generated per month		Type & amount consumed per month	
			Type	Amount (qtl/month)	Type	Amount (qtl/month)